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The construction and performance characteristics of PVC electrodes for Oxomemazine Hydrochloride

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ABSTRACT

The construction and performance characteristics of PVC electrodes for oxomemazine hydrochloride (OXCl) are described. Different methods for electrodefabrication (modified with the ion-pair, ion pairing agent or soaking the plain electrode in the ion-pair suspension) have been used. Matrix compositions were optimized on the basis of effects of type and content of the modifier as well as influence of the plasticizers. The fabricated electrodes worked satisfactorily in the concentration range from 1×10^{-6} to 0.001 M with Nernstian cationic slopes, depending on the method of electrode fabrication. The ion-pair modified electrode showed the best performance (slope59.7 ± 2.1 mVdecade^{-1}) compared with the plain electrodes or modified with sodium tetraphenylborate (NaTPB) and fast response time of about 15 s and adequate lifetime (6 weeks).The developed electrodes have been successfully applied as end point indicator electrode for the potentiometric titration of OXCl with high accuracy and precision.

Key words: Oxomemazine HCl, pharmaceutical analysis, ion-selective electrodes and potentiometry titration

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INTRODUCTION

Oxomemazine, a phenothiazine derivative, is an antihistamine used for the symptomatic relief of hypersensitivity reaction. It is also an ingredient of compound preparations for the symptomatic treatment of cough and the common cold. It is given orally in doses equivalent to 10 to 40 mg of oxomemazine daily. Oxomemazine may also be administered rectally in form of suppositories. Oxomemazine hydrochloride (OXCl) has been used similarly by mouth. It is chemically known as [3-(5,5-dioxodo-10H-phenothiazin-10-yl)-N,N,2-trimethylpropan-1-amine] (Figure 1).The assay of the drug in pure and dosage forms is, as far as we know, not official in any pharmacopoeia, and therefore requires much more investigation. The different analytical techniques that have been reported for its determination including spectrophotometry [2, 3], and HPLC [4]. Regarding the quality control, it is used in pharmaceutical industry to analyze starting materials, intermediates, and finished products.

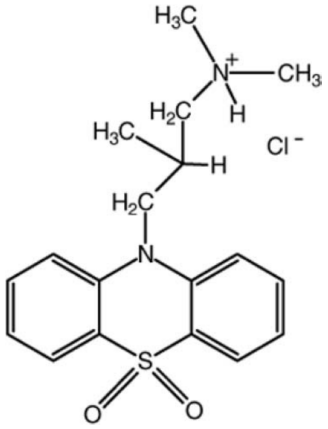

Fig.1The chemical structure of OXCl

Ion-selective electrode (ISEs) are electrochemical sensors based on a thin selective membrane or a film, allowing the potentiometric determination of the activity of certain ions in the presence of other ions in the sample solution. In recent years, ISEs have been used for the determination of solubility products of different sparingly soluble salts. In spite of the successful progress in the design of highly selective electrodes for various ions, there has not been any report on the development of selective and sensitive sensors for oxomemazine[11].

The present study is concerned with preparation, characterization and application of simple potentiometric sensors for rapid determination of OX. Electrodes were fabricated in plain and modified forms and then subjected to a series to test to select sensor possessing the most favorable analytical characteristics. The developed sensors were also applied as indicator electrode in the potentiometric titration of OX[5, 6,7].

MATERIALS AND METHODS

Materials

All reagents used throughout the work were of analytical reagent grade. Bidistilled water was used throughout all experiments. Oxomemazine hydrochloride (OMCl, Mwt = 366.91) and its pharmaceutical preparation were provided by (EUROPEAN EGYPTIAN Pharmaceutical INDUSTRIES Company) (ALEXANDRIA-EGYPT).

Sodium tetraphenylborate (NaTPB) $Na[C_{24}H_{20}B]$(Fluka), Sun flower oil , Corn oil , Olive oil , as natural plasticizers, poly vinyl chloride (PVC) of relatively high molecular weight (Aldrich), Tetrahydrofuran (THF) (Aldrich), Graphite powder 1-2 micron from Aldrich, Sodium chloride (NaCl), Potassium chloride (KCl), Ammonium chloride (NH_4Cl), Calcium chloride ($CaCl_2$), Magnesium chloride ($MgCl_2.6H_2O$), Ferric chloride ($FeCl_3$), Nickel chloride ($NiCl_2.6H_2O$), Zinc sulphate ($ZnSO_4$), Barium chloride ($BaCl_2.2H_2O$), Strontium chloride ($SrCl_2$), Cobalt chloride ($CoCl_2$) were obtained from Riedel de HaenChemical Company, Glucose, Lactose, Maltose, Fructose, Sucrose, D-alanin, Glycine, Thiamine hydrochloride (vitamin B_1), pyridoxine hydrochloride (vitamin B_6) were obtained from Aldrich chemical company.

Methods

All potential measurements were performed using a 3510 Jenway pH meter with PC interface, equipped with silver-silver chloride double junction reference electrode in conjugation with the sensing drug ISE. A combined pH glass electrode was used for all pH measurements.

In plastic membrane electrodes, the amount of lipophilic salt should be sufficient to obtain reasonable ionic exchange at the gel layer-test solution interface, which is responsible for the membrane potential. Also, the amount of the plasticizer should be to the extent that produces a membrane of good physical properties and at the same time plays efficiently its role as a solvent mediator for the ion-exchanger(s) lipophilic salts.

In the present investigation, poly (vinyl chloride) (PVC) membranes plasticized with corn oil and containing the lipophilic salt, OM-TPB were prepared.

Ion-selective electrodes containing different membranes compositions were prepared to select the optimum composition exhibiting the best performance characteristics, e.g. slope, linear range, different compositions of the membranes and the slope (mV/concentration decade) of the obtained calibration graphs. Each membrane was prepared three times and the calculated relative standard deviations of the slope value were always very small showing the reproducibility of the preparation process. Freshly prepared electrodes must be soaked in drug solution to form an infinitesimal thin gel layer at which ion exchange occurs. This preconditioning process requires different soaking times depending on diffusion and equilibration at the interface, fast establishment of equilibrium is certainly a sufficient condition for fast response [8-12]. The soaking time differ according to the electrode types. Study of the soaking time showed that 15 minutes were satisfactorily for all the electrodes.

RESULTS AND DISCUSSION

1. Effect of Composition

Comparing the slope values of the calibration graphs obtained using the different compositions. The optimum compositions exhibiting the best performance, for OM-TPB 5% ion associate, 47.5% PVC and 47.5% corn oil as shown in table1.

Table 1.Composition of oxomemazine plastic membrane electrodes and slopes of their corresponding calibration graphs at 25±1°C and 30 min. of soaking in 10^{-3}mol $L^{-1}$of OMCl

OM-TPB electrodes	Composition % (w/w)				
Parameters	Ion associate 3	Ion associate 5	Ion associate 7	Ion associate 9	Ion associate 12
PVC	48.5	47.5	46.5	45.5	44.0
Corn oil	48.5	47.5	46.5	45.5	44.0
Slope mV/decade	51.5	59.7	58.2	56.1	50.9
RSD %	1.08	1.79	0.72	0.44	1.45
Linearity range (mol L^{-1})	$1.9x10^{-5}$-$1.0x10^{-2}$	$3.1x10^{-5}$-$1.0x10^{-2}$	$2.5x10^{-5}$-$1.0x10^{-2}$	$3.9x10^{-5}$-$1.0x10^{-2}$	$5.0x10^{-5}$ - $1.0x10^{-2}$
LOD (mol L^{-1})	$1.5x10^{-5}$	$2.5x10^{-5}$	$1.9x10^{-5}$	$3.1x10^{-5}$	$3.9x10^{-5}$
LOQ (mol L^{-1})	$4.99x10^{-5}$	$8.32x10^{-5}$	$6.32x10^{-5}$	$10.32x10^{-4}$	$12.98x10^{-4}$
Response time (s)	10	10	10	10	10

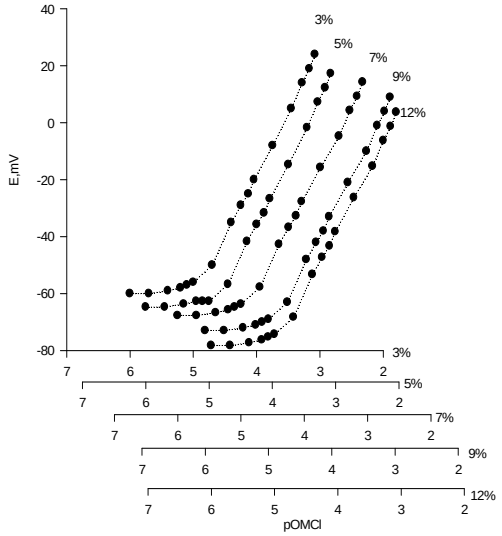

Fig. 2. Calibration graphs using OM-TPB PVC electrodecorn oil at different ion associate percentage.

2. Effect of plasticizer

The plasticizers used have a significant influence on the response of the electrodes. three plasticizers with different

polarities including Corn oil, Sunflower oil , and olive oil were examined as solvent mediator (Table 2). Different plasticizer/PVC (w/w) ratios were studied; the 1:1 plasticizer/PVC ratio produce maximum sensitivity for all the plasticizers. The results reveal that olive oil is the best of the plasticizers tested in case of OM-TPB and sun flower oil, respectively. Poor sensitivities for the electrodes plasticized by other plasticizers are due to low solubility or low distributions of OM-TPB ion exchangers in these solvents. The electrodes using olive oil, as a plasticizer provided not only higher Nernstian slope but also a wider response, more stable potential reading and a lower limit of detection.

Table 2.Effect of plasticizers on oxomemazine responsive membrane electrodes and slopes of their corresponding calibration graphs at 25±1°C and 30 min soaking in 10^{-3}mol L^{-1} of OMCl.

OM-TPB electrodes	Plasticizer (5%)			
Parameters	Without plasticizer	Corn oil	Sun flower oil	Olive oil
Slope mV/decade	56.1	59.7	52.6	59.7
RSD %	0.84	1.11	0.46	0.74
Linearity range (mol L^{-1})	$1.5x10^{-5}$-$1.0x10^{-2}$	$3.1x10^{-5}$-$1.0x10^{-2}$	$3.1x10^{-5}$-$1.0x10^{-2}$	$6.3x10^{-5}$-$1.0x10^{-2}$
LOD (mol L^{-1})	$1.2x10^{-5}$	$2.5x10^{-5}$	$2.5x10^{-5}$	$3.9x10^{-5}$
LOQ (mol L^{-1})	$3.99x10^{-5}$	$8.32x10^{-5}$	$8.32x10^{-5}$	$12.98x10^{-4}$
Response time (s)	10	10	10	10

3. Effect of buffer

Using of different buffers as shown in table (3) note that phthalate buffer give the highest slope with lower differences. This indicate that the electrode condition stable and the change by adding buffer solutions is low.

Table 3. Effect of buffer on oxomemazine responsive membrane electrodes and slopes of their corresponding calibration graphs at 25±1°C and 30 min soaking in10^{-3}molL^{-1} of OMCl.

OM-TPB electrodes Parameters	Buffer		
Parameters	Phosphate	Acetate	Phthalate
Slope mV/decade	58.2	59.7	59.8
RSD %	0.38	0.39	0.68
Linearity range (mol L^{-1})	$3.1x10^{-5}$-$1.0x10^{-2}$	$1.9x10^{-5}$-$1.0x10^{-2}$	$3.1x10^{-5}$-$1.0x10^{-2}$
LOD (mol L^{-1})	$2.5x10^{-5}$	$1.5x10^{-5}$	$1.9x10^{-5}$
LOQ (mol L^{-1})	$8.32x10^{-5}$	$4.99x10^{-5}$	$6.32x10^{-5}$
Response time (s)	10	10	10

4. Effect of soaking on life-span of the PVC membrane electrodes.

Freshly prepared electrodes must be placed in soaking solutions to activate the surface of the membrane by forming an infinitesimal thin gel layer at which ion-exchange process occurs. This preconditioning requires different soaking intervals depending on diffusion and equilibrium at the interface; fast establishment of equilibrium is certainly a sufficient condition for fast response. The performance characteristics of the investigated electrodes were studied as a function of soaking times. For this purpose, the electrodes were soaked in 10^{-3} M solution of OMCl for different time intervals (starting from 30 minutes reaching about 45 days) and then the effect of soaking on the calibration graph slope, usable concentration range and the response time was studied for each electrode independently. The results indicate that in case of (OM-TPB) electrode corn oil , the slope of the calibration graph was 59.8 mV $decade^{-1}$ after 30 min and remains constant till 24 hours, then decreased reaching nearly 59.7, 58.2, 56.1, and 50.9 mV $decade^{-1}$ after 2, 8, 21,30, and 45 days of soaking. In case of OM-sun flower oil electrode the slope of the calibration graph was59.7 mV $decade^{-1}$ after 30 min and remains constant till 2days, then decreased 58.5, 56.4 and 50.9mV $decad^{-1}$ after 8, 21,30 and 45 days of soaking, respectively, Table (4).

The life span of the electrode is closely related to the nature of ion-exchanger, and its rate of leaching to the bathing solution. Continuous soaking of the electrodes for elongated intervals of time affected negatively their response to the drug cation. This negative effect of soaking is attributed to the leaching of the ion-exchanger and plasticizer to the bathing solution. This related to the distribution equilibria and diffusion rates[11,14,20].

Table 4. Effect of soaking on plastic membrane electrodes at 25.0 ± 1.0 °C.

OM-TPB electrodes	Soaking time					
Parameters	0.5-24 h	2 days	8 days	21 days	30 days	45 days
Slope mV/decade	59.7	59.7	58.5	56.4	50.9	50.9
RSD %	1.22	1.79	0.86	1.45	1.43	0.98
Linearity range(mol L^{-1})	$3.9x10^{-5}$-$1.0x10^{-2}$	$3.9x10^{-5}$-$1.0x10^{-2}$	$2.5x10^{-5}$-$1.0x10^{-2}$	$1.5x10^{-5}$-$1.0x10^{-2}$	$3.1x10^{-5}$-$1.0x10^{-2}$	$1.9x10^{-5}$-$1.0x10^{-2}$
LOD (mol L^{-1})	$3.1x10^{-5}$	$3.1x10^{-5}$	$1.9x10^{-5}$	$1.2x10^{-5}$	$2.5x10^{-5}$	$1.5x10^{-5}$
LOQ (mol L^{-1})	$10.32x10^{-4}$	$10.32x10^{-4}$	$6.32x10^{-5}$	$3.99x10^{-5}$	$8.32x10^{-5}$	$4.99x10^{-5}$
Response time (s)	10	10	10	10	10	10

5. Effect of internal filling solution:

Using a series of different filling solutions in order to choose the best conditions of electrodes in case of corn oil the best concentration of filling solution is 10^{-2}mol L^{-1}OMCl +10^{-1}mol L^{-1}NaCl and in case of sun flower oil the best condition 10^{-3}mol L^{-1}OMCl +10^{-1}mol L^{-1}NaCl.

Table 5. Effect of internal filling solution on oxomemazine responsive membrane electrodes and slopes of their corresponding calibration graphs at 25±1°C and 30 min soaking in 10^{-3}mol L^{-1} of OMCl.

OM-TPB electrodes	Filling solution mol L^{-1}					
Parameters	10^{-2}OMCl	10^{-3}OMCl	10^{-4}OMCl	10^{-2}OMCl+10^{-1}NaCl	10^{-3}OMCl+10^{-1}NaCl	10^{-4}OMCl+10^{-1}NaCl
Slope mV/decade	56.1	50.9	49.2	59.8	58.2	49.8
RSD %	0.54	0.43	0.51	0.58	0.87	0.75
Linearity range (mol L^{-1})	$1.5x10^{-5}$-$1.0x10^{-2}$	$3.1x10^{-5}$-$1.0x10^{-2}$	$1.5x10^{-5}$-$1.0x10^{-2}$	$3.9x10^{-2}$ $1.0x10^{-2}$	$2.5x10^{-5}$-$1.0x10^{-2}$	$3.1x10^{-6}$-$1.0x10^{-2}$
LOD (mol L^{-1})	$1.2x10^{-5}$	$2.5x10^{-5}$	$1.2x10^{-5}$	$3.1x10^{-5}$	$1.9x10^{-5}$	$1.9x10^{-6}$
LOQ (mol L^{-1})	$3.99x10^{-5}$	$8.32x10^{-5}$	$3.99x10^{-5}$	$10.32x10^{-4}$	$6.32x10^{-5}$	$6.32x10^{-6}$
Response time (s)	10	10	10	10	10	10

6. Response time of the ion selective electrodes

The response time is the time which elapses between the instant when an ion-selective electrode and a reference electrode (ISE cell) are brought into contact with a sample solution (or at which the activity of the ion of interest in a solution is changed) and the instant at which the emf /time slope ($\Delta E/\Delta t$) becomes equal to a limiting value selected on the basis of the experimental conditions and on some requirements concerning the accuracy. The response time of the investigated electrodes was calculated according to this definition.

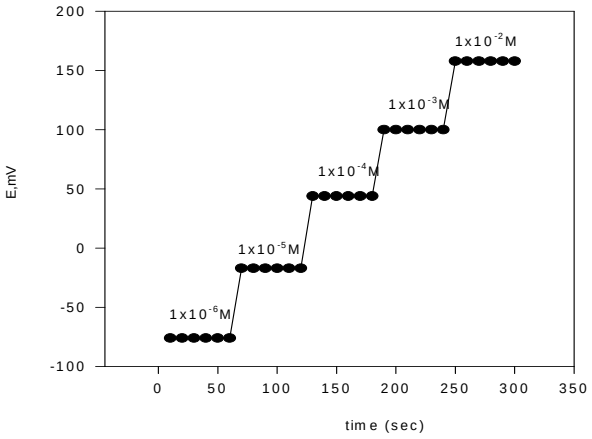

Fig.3. potential-time plot for OM-TPB corn oil electrode.

7. Effect of pH

The effect of pH of the test solution on the potential readings of the developed electrodes was studied in batch conditions. The variation in potential with change in pH was followed from pH 2.0 to pH 12.0 by the addition of small volumes of hydrochloric acid and sodium hydroxide (each 0.1-1.0 M) to 10^{-2} ,10^{-3} and 10^{-4} M solution of OMCl. The results indicated that the electrode did not respond to the pH change in the range 2.0-9.8 for OM-TPB corn oil and OM-TPB sun flower oil electrodes Figure (4). The decrease in potential occurring at higher pH values is most probably attributed to formation of the free oxomemazine base in solution, leading to a decrease in concentration of oxomemazine cation: pK_a= 10.6) [15,16,17,21].

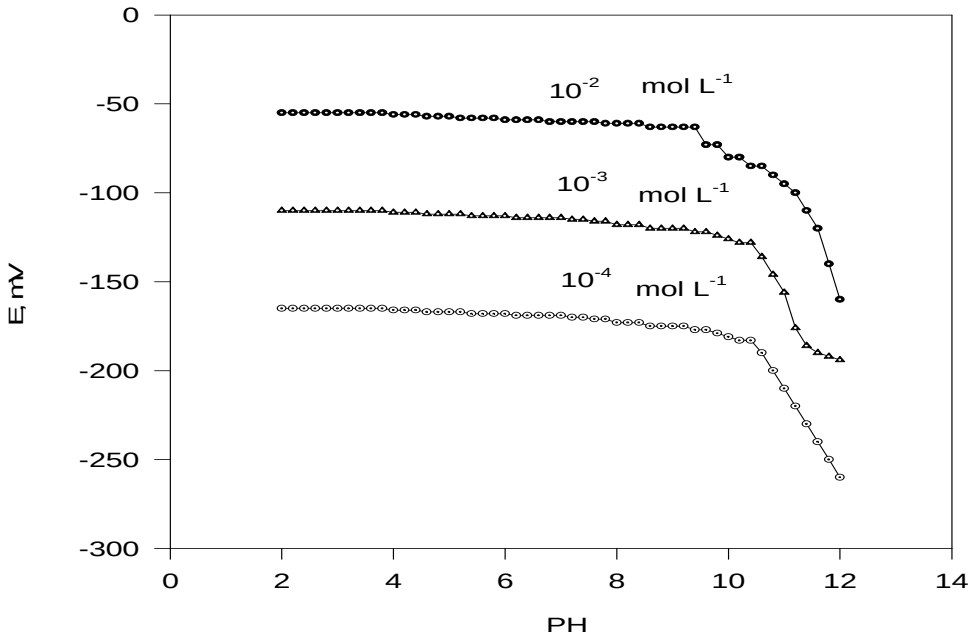

Fig. 4. Effect of pH of the test solution on the potential response using OM-TPB PVC corn oil electrode.

8. Effect of temperature

8. 1. Thermal stability of the electrodes

To study the thermal stability of the electrodes, calibration graphs ($E_{elect.}$vsp drug) were constructed at different test solution temperature covering the range 30-70 °C. The slope and usable concentration range of the electrode at different test solution temperature are given in Table (6) for OM-TPB corn oil and sun flower oil electrodes. The results indicate that the slopes of the calibration graphs slightly increase, however, still in the Nernstian range in spite of the increase of the temperature of the test solutions up to 70°C.

8.2. Determination of the thermal coefficient of the electrodes.

The potential of ion-selective electrodes is usually affected by the temperature of the test solution. A thermally stable electrode is characterized by low thermal coefficient. This means the successful applicability of the electrode over a wide range of temperature. To calculate the thermal coefficient (dE°/dt) of the cell, the standard cell potentials, $E°_{cell}$, were determined at different temperatures from the respective calibration plots as the intercept of these plots at pdrug = 0, knowing that $E°_{cell}$ is related to (dE°/dt) by the equation[18,19,22].

$$E°_{cell} = E°_{25°C} + (dE°/dt)\,(t-25) \quad (1)$$

Plot of ($E°_{cell}$) versus (t-25) produced a straight line; the slope of this line is taken as the thermal coefficient of the cell.

The value of the standard potentials of electrodes ($E°_{elec.}$) were calculated after the subtraction of the standard electrodes potential of the calomel electrode at different temperatures. Plots of ($E°_{elec}$) versus (t-25) for each electrode gave a straight line, The slope of the line was taken as the thermal coefficient of the electrode. The values of $(dE°/dt)_{cell}$ are 1.00 x 10^{-3} and the value of $(dE°/dt)_{electrode}$ are 1.665 x 10^{-3} for OM-TPB corn oil. revealing the

high thermal stability of the studied electrodes within the investigated temperature range and show no deviation from the theortical Nernstian behavior.

Table 6. Performance characteristics of oxomemazine plastic membrane Corn oil electrodes at different temperatures.

OM-TPB electrodes	Temperature ^{o}C.				
Parameters	30	40	50	60	70
Slope mV/decade	56.1	58.2	58.8	59.7	60.0
RSD %	1.22	1.83	2.64	0.78	1.50
Linearity range(mol L^{-1})	$1.2x10^{-5}$-$1.0x10^{-2}$	$5.0x10^{-6}$-$1.0x10^{-2}$	$1.5x10^{-5}$-$1.0x10^{-2}$	$2.5x10^{-5}$-$1.0x10^{-2}$	$3.9x10^{-5}$-$1.0x10^{-2}$
LOD (mol L^{-1})	$1.0x10^{-5}$	$3.9x10^{-6}$	$1.2x10^{-5}$	$1.9x10^{-5}$	$3.1x10^{-5}$
LOQ (mol L^{-1})	$3.33x10^{-5}$	$12.98x10^{-5}$	$3.99x10^{-5}$	$6.32x10^{-5}$	$6.32x10^{-5}$
E^{o} cell Mv	160	170	180	190	200
Response time (s)	10	10	10	10	10

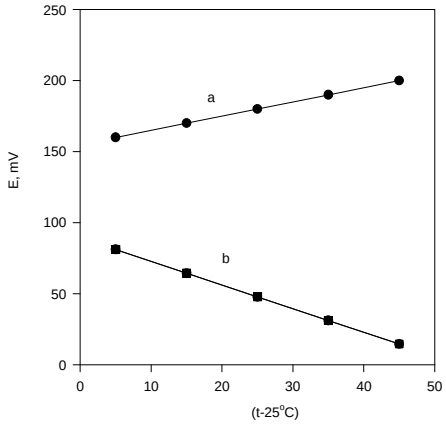

Fig. 6. Variation of the cell e.m.f (a) and standard electrode potential (b)with temperature for OM-TPB PVC corn oil electrode.

9. Selectivity of the electrodes.

The selectivity coefficient $K^{pot}_{OM,J^{Z+}}$ is the main source of information concerning interference on the electrode response. In analytical applications, the selectivity for the analyte must be as high as possible, i.e. the selectivity for foreign substances must be very small, so that the electrode exhibits a Nernstian dependence on the primary ion over a wide concentration range. The selectivity of the ion-exchanger of the sensor depends on the selectivity of the ion exchange process at the sensor-test solution interface and the mobilities of the respective ions in the matrix of the sensor. The hydrophobic interactions between the primary ions and the sensor are reflected by the values of the Gibb's energy of transfer for ions between aqueous and sensor phase.

The response of the electrodes towards different substances and ionic species such as inorganic cations, amino acids, sugars, vitamines was checked. The values of selectivity coefficients $-\log K^{pot}_{OM,J^{Z+}}$, shown in Table(7),were used to evaluate their degree of interference.

Since many years, the method of determination of selectivity coefficients of electrodes in potentiometric measurements was a subject of discussion in the literature [23,24].Two specialized IUPAC committees were held concerning the determination of potentiometric selectivity coefficients[25]. In the first IUPAC committee held in 1975, [27].The separate solution method (SSM) was recommended only if the electrode exhibits Nernstian response, but it was considered less desirable compared to fixed interference method (FIM), because it does not represent as well the actual conditions under which the electrodes are used. In 1995, the second IUPAC committee on methods for reporting selectivity coefficients, recommended the matched potential method (MPM) which is independent of

Nicolsky Eisenman equation[26].

In batch measurements of the present study, selectivity coefficients were determined by separate solution method (SSM) for ionic species and in case of neutral species the selectivity coefficients were determined by matched potential method (MPM). The selectivity coefficients value $-\log K^{pot}_{OM,J^{Z+}}$ of the electrodes listed in Table (7). reflect a high selectivity of these electrodes towards oxomemazine cation.

The mechanism of selectivity is mainly based on the stereospecificity and electrostatic environment and it is dependent on how much fitting is present between the locations of the lipophilicity sites in the two competing species in the bathing solution side and those present in the receptor of the ion exchanger [27]. Inorganic cations do not interfere because of differences in ionic size, mobility and permeability. In cases of sugars, amino acids and vitamins, the high selectivity is mainly attributed to the difference in polarity and to the lipophilic nature of their molecuoles relative to OMCl.

Table 7. Selectivity coefficients $-\log K^{pot}_{OM,J^{Z+}}$ for the OM corn oil electrodes

	OM-TPB	
Interferent	SSM	MPM
Na^+	2.79	2.76
K^+	1.90	1.85
NH_4^+	1.85	2.65
Ca^{2+}	3.56	4.50
Mg^{2+}	3.69	3.86
Co^{2+}	3.51	4.20
Zn^{2+}	3.37	3.48
Ni^{2+}	3.89	2.76
Sr^{2+}	4.24	5.68
Ba^{2+}	3.55	3.20
Fe^{3+}	3.55	5.48
Cu^{2+}	3.22	6.30
Cd^{2+}	4.20	4.68
Glucose	-	2.36
Fructose	-	2.16
Maltose	-	2.38
Lactose	-	2.31
Alanine	-	2.27
Glycine	-	2.24
Urea	-	2.13
Ascorbic acid	-	2.16

10.Analytical Applications

Several methods are applied for quantitative analysis using ion-selective electrodes. These comprise: (i) Direct calculation of the concentration applying Nernst equation. This method is subjected to several sources of errors e.g.1mV shift in electrode potential reading leads to 4n % errors where n is the change of the ion. (ii) potentiometric titration involving the use of counter ion as titrant ion which is more accurate depending essentially on the use of ISE as end point detector. (iii) The standard addition method, which is frequently applied in using ISE.

10.1 Potentiometric determinations applying the standard addition method in batch conditions

The standard addition method, described in the experimental part, was proved to be successful for the determination of oxomemazine in pure solutions and in pharmaceutical formulations, using the prepared electrodes as sensors.

10.2 Determination of the drug in bulk and pharmaceutical formulation

The standard addition method, described in the experimental part, was proved to be successful for the determination of OM-TPB corn oil in pure solutions by using the respective electrode as sensor. This is clear from the small RSD values in ranges 2.69-2.91, 3.88-5.06, and 0.85-2.69% for OM-TPB plastic membrane with corn oil, which reflects the high accuracy and precision of the electrodes.

10.3Potentiometric titrations

Though, the determination of concentration using potentiometric titration is time consuming, offers the advantage of high accuracy and precision, the end point can be easily determined by a sharp potential break, also, the use of partially exhausted electrode is possible and the actual potential value at the end point is of secondary interest [28].

The main idea of this type of titration depends on ion-associates formation. The feasibility of such titration depends on degree of completeness of the reaction. Since the equilibrium constant of precipitation titration is inversely proportional to the solubility product, it is natural that the smaller the solubility product of the formed ion-exchanger, the sharper is the end point. So, the determination of the solubility product of the precipitate is of prime importance if a titration, leading to the formation of this precipitate is under investigation. The reciprocal of the solubility product is approximately equal to the equilibrium constant of the precipitation reaction employed in the titration. Moreover, it has been shown[29,30] that in a precipitation titration curve, the point with maximum slope may slightly precede the equivalence point if the solubility product of the precipitate formed is relatively high.

The OM-TPB electrodes were proved to be useful for the determination in pure solutions by potentiometric titration against standard solution of sodium tetraphenylborate. Representative titration curves are shown in at which, it is noticed that as the concentration of the drug increases, the inflection of the break point becomes more sharper than low drug concentration. The relative standard deviation (RSD) and the recovery values are listed in table(8).

Table (8.).Determination of OMCl in pure solution and pharmaceutical preparations applying the standard addition method on 5% corn oil

	(plastic membrane corn oil)			
Sample	Taken (mg)	Found (mg)	Mean Recovery (%)	RSD (%)
OM-TPB	10.80	10.80	100	2.69
pure solution	21.60	22.40	96.4	2.91
	32.40	32.72	101	2.44
	43.20	42.72	98.9	2.91
Toplexile syrup	32.72	32.06	98	3.88
	65.44	65.44	100	4.66
	98.16	97.17	99	5.06
Rectoplexilesuspositotry	3.30	3.29	99.9	0.85
	6.60	6.81	96.9	0.63
	9.90	10.16	102.7	2.38

Table (9).Determination of OMCl in pure solution applying potentiometric titrations method on 5% corn oil.

Sample	Taken ml	Found ml	Mean Recovery (%)	**RSD (%)**
OM-TPB	3	3.0	99.5	2.67
pure solution	6	6.1	97.3	2.59
	9	9.8	99.1	2.38

(plastic membrane electrodes potentiometric titrations)

CONCLUSION

The present work has successfully demonstrated the fabrication of OX-PVC electrode utilizing different preparation methods. The fabricated electrodes showed Nernstian slopes in the concentration range 10^{-6}-10^{-2}mol L^{-1} with fast response time (15 s), and long operational lifetime (6weeks). The fabricated electrodes were successfully applied as end point indicator electrode for potentiometric titration of OX with NaTPB in the concentration range 10^{-6}-10^{-2}mol L^{-1} with good accuracy and sensitivity the fabricated electrode possessed shorter response time(10 s) compared with drug electrode.

REFERENCES

[1] Jacob RM , Robert JG (**1961**) US Patent to Societe des UsinesChimiquesRhone-poulenc(france) 2, 972: 612.
[2] Zivanov-Stakic D , Deric L (**1979**) *Arch Farm* 29:21-24.
[3] Akram M. El-Didamony (**2005**) *Arch Pharm Chem Life Sci* 338:190-197.
[4] Hoogewijs G, Massart DL (**1984**) *J Pharm Biomed Anal* 2:449-463.
[5] Vytras K. (**1985**) *Electrode Rev* 7:77.
[6] Issa YM, Shoukry AF, and El-Nashar RM. (**2001**) *J Pharm Biomed Anal* 26:379-386.

[7] Shoukry AF, Abdel-Ghani NT, Issa YM, and Ahmed HM (**1999**) *Electroanalysis* 11: 443- 446.
[8] Antropov LL (1977) Theoretical Electrochemistry, Mir, Mosco, **1977**.
[9] Abdel-Ghani NT, Shoukry AF, Hussein SH (**2002**) *J Parm. Biomed Anal* 30:601-611.
[10] Khaled E, Hassan HNA , Kamel MS, Barssoum BN (**2007**) *Curr Pharm Anal* 3:262-267.
[11] Buck RP , Lindner E (**1994**) *Pure Appl. Chem* 66: 2527-2536.
[12] Eisenman G (**1968**)R.A. DurstP.I. National Bureau Standards (U.S) spec Publ.Washington,D.C. 314.
[13] J isoe, E kaneko, S hoshi, K Akatsuka. Bunseki Kagaku **2002**;51:657.
[14] Armstrong R.D. ,Horvai G(**1990**) *Electrochem.Acta*,35:1.
[15]Vytras K (**1990**) *Czech Chem. Commun* 55:941-950.
[16] Vytras K, Kalous J, Jezkova J (**1997**) *J. Anal. Chem*., 6:107-123.
[17] Elmonem MA, Abdulla SA (**2014**) *Res.J.Pharm.Bio.Chem. Sci*., 5:1113-1125.
[18] Reda Ammar A , Haleemaotaif, and Abdulrhman Al-warthan (**2012**) *Int. J. Electrochemsci* 7 :2531-2542.
[19] Ali TA, Mohamed GG, El-Dessouky MMI, ElElla SMA, RTF Mohamed (**2013**) *Int.J.Electrochem.Sci* ., 8: 1469-1486.
[20] Armstrong R.D. , Horvai G, (**1990**) *Electrochem.Acta*, 35:1.
[21] Meloum M. SyrovyT.Vrana A.,(**2004**)*Talanta* 62:522.
[22] OeschV., SimonW.(**1986**) *Clin.chem*, 32:1148.
[23] Nagele M.,yanming M, Bakker E.,pretsch E. ,(**1998**) W.(**1986**) *Anal. Chem.*, 70:1686.
[24] Yoshida M. ,Matsui K.,Maeda .K,Kihara S. ,(**1998**) *Anal. Chem. Acta*, 374:269.
[25] Guilbault G.G. ,(**1971**) *pure Appl. Chem*.,25:727.
[26] UmezawaY., Umezawa K.,Buhlmann .K ,TohdaK. ,AmemiyaS.(**2000**) *Pure Appl Chem*.,72:1851.
[27] Abdel Ghani N.T.RizK M.S.RizKR.M. , El-Nashar R.M.., (**2000**) *Analyte* 125:1129.
[28] IIcheva L. , Trojanowicz M. ,Velkrawczyk T.K. , (**1993**) Fresenius Z.
[29] Vytras K., (**1989**) *J. pharm.Biomed. Anal*. ,7:789.
[30] Meites L. Goldman J.A. , (**1964**) *Anal. Chem. Acta* ,30:200.